RESEARCH PAPER International Journal of Agricultural Sciences, Vol. 5 Issue 1, January to May, 2009 : 168-172

Effect of nitrogen and potassium on growth and yield of frenchbean and potato grown in intercropping system

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ABSTRACT

A field experiment was conducted during winter season of 2003-04 and 2004-05 at J.V.P.G. College, Baraut (Bagpat) in western Uttar Pradesh to study the optimum dose of nitrogen for component crop in the sole french bean *(Phaseolus vulgaris* Linn.) and patato *(Solanum tubersum* L.) and in intercropping system. Frenchbean and Potato yields increased significantly upto the application of 120Kg N and 60 Kg K_2O/ha. Frenchbean equivalent yield was highest of 31.90 q/ha at 120 kg N/ha and 29.63 q/ha which were found 2.28 q/ha (7.9%) and 6.88 q/ha (28.2%) higher than the equivalent yield in sole potato and sole frenchbean, respectively. Intercropping attained 1.17 L.E.R. which indicates that land may be utilized by 17 per cent more than pure cropping.

Key words : French bean, Potao, Potassium and Nitrogen application.

INTRODUCTION

French bean crop unlike other pulses, is assured crop responding well to irrigation and fertilizers. It gets favour of progressing farmers under input intensive agriculture. It produces 25-30 quintal grain per hectare which corresponds to 100-120 q/ha of wheat. It is grown with intensive inputs suitable for cultivation in relay cropping and inter cropping systems. Potato is in an important crop of north India, grown with intensive inputs.

French bean may be suitable crop for growing with potato as intercrop because it also responds to higher inputs. Therefore, the present investigation was carried out on intercropping of french bean with potato in western Uttar Pradesh, where intensive agriculture with higher inputs is mostly adopted.

Nitrogen and potassium both elements are of great importance in crop production. It is essential in the formation and transfer of starches and sugar thus required in large quantities for the crop like potato. It counteracts the injuries effect of excess nitrogen in plants (Yawalkar *el al.*, 1977). Inter cropping of potato with french bean in *rabi* has been advocated by Ali and Lal (1991) and french bean + potato 3:2 ratio is ideally remunerative crop Ahalawat, 1998.

MATERIALS AND METHODS

A field experiment was carried out during the winter season of 2003-04 and 2004-05 at Janta Vedic Post Graduate College, Baraut (Baghpat). The soil was silt loam having 0.30 and 0.36% organic carbon, 14.5 and 15.0 Kg/ha available P and; 275 and 263 Kg/ha available K with pH 7.5 and 7.4 pH values in two years of experimentation. The treatments consisted of two sole stands each of frenchbean and potato in intercrop association of french bean + potato in 3:2 row ratio at 45 cm row spacing in all cases. These three systems were applied with three levels of K (0, 30 and 60 kg K_2O/ha). and four N levles (0, 60, 120 and 180 Kg N/ha). Combination of cropping systems and K levels were kept in main plots while, N levels were tried in sub plot of split plot design replicated thrice. Frenchbeen variety 'Amber' and Potato variety 'Khufri Chandramukhi' were sown on 26 October and 30 October with 125 kg/ha seed of frenchbeen and 25q/ha potato seed tuber. A uniform basal dose of 80 Kg P_2O_5/ha through single super phosphate was applied on row basis sown in different treatments. Potato crop was digged on 16th and 18th Feb. while frenchbean was harvested on 10th and 15th March during two years. The important result of investigation on pooled basis over years are presented for evaluation of french bean effect.

RESULTS AND DISCUSSION

Frenchbean :

Effect of cropping system:

Plant stand of french been was significantly high in pure cropping than intercropping because in inter cropping only 60 per cent area was sown with french bean against 100 per cent in pure cropping. french bean in intercropping showed significantly high values of growth characters crop growth rate, relative growth rate, net assimilation rate and dry matter accumulation per plant than in sole cropping. The better growth of french bean in intercropping might be due to availability of more space particularly above ground which was utilized by crop plants in their development by taking the advantage of

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Table 1 : Effect of treatments of different plant characters and yield of french bean (Pooled over 2 years)

Treatment	Plant population/ ha	Plant height (cm)	No. of branches per plant	Dry matter per plant (g)	Crop growth rate (g/m²/day)			Relative growth rate (mg/g/day)			Net assimilation (mg/dm²/day)			No. of Pods/ plant	Pod length (cm)	100 grain wt. (g)	Grains yield (q/ha)	Straw yield (q/ha)
					38-70 DAS	70-105 DAS	105-140 DAS	38-70 DAS	70-105 DAS	105-140 DAS	38-70 DAS	70-105 DAS	105-140 DAS					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Cropping systems																		
Pure	31000.0	45.65	5.19	18.92	8.042	7.560	7.008	28.162	22.432	8.628	1.203	0.933	1.011	10.56	8.20	43.01	24.41	28.46
Intercropping	18236.2	45.78	5.17	19.46	8.685	7.548	7.355	29.531	23.960	9.855	1.297	1.076	1.108	11.25	8.51	43.95	15.92	18.88
S.E.±	1690	0.20	0.09	0.10	0.073	0.102	0.082	0.231	0.143	0.095	0.025	0.009	0.017	0.10	0.08	0.17	0.19	0.53
C.D. (P=0.05)	3525	N.S.	N.S.	0.22	0.152	0.213	0.170	0.483	0.298	0.199	0.052	0.020	0.035	0.39	0.16	0.36	0.40	1.10
K-levels (Kg/ha)																		
K_0	245000	44.55	5.06	18.22	7.843	7.199	6.845	27.340	22.131	8.308	1.135	0.936	0.971	10.00	8.14	42.46	18.70	22.37
K_{30}	246250	45.58	5.31	19.09	8.604	7.547	7.234	29.096	23.370	9.395	1.342	0.985	1.036	10.90	8.34	43.48	20.42	23.72
K_{60}	247292	47.02	5.16	20.25	9.003	8.515	7.643	30.113	24.088	10.025	1.274	1.092	1.161	11.83	8.58	44.52	21.38	24.93
S.E. ±	2069	0.24	0.11	0.13	0.089	0.125	0.100	0.283	0.175	0.177	0.030	0.012	0.021	0.23	0.09	0.21	0.24	0.65
C.D. (P=0.05)	N.S.	0.50	N.S.	0.26	0.186	0.260	0.209	0.591	0.365	0.244	0.034	0.024	0.043	0.48	0.19	0.44	0.50	1.53
N-Levels (Kg/ha)																		
N_0	24000	12.61	4.34	18.83	6.921	6.428	6.326	26.162	21.488	8.636	1.238	0.984	0.871	7.75	6.32	40.97	15.57	20.72
N_{60}	245277	44.64	5.22	18.78	8.138	7.446	6.984	28.981	23.074	9.290	1.268	0.983	1.072	9.86	6.32	43.26	19.49	22.71
N_{120}	247667	47.80	5.58	20.21	9.138	8.614	7.445	29.654	23.817	9.706	1.291	1.019	1.1899	12.56	9.18	44.60	22.86	25.49
N_{180}	247778	48.61	5.59	20.92	9.305	8.526	7.969	30.580	24.407	9.335	1.206	1.032	1.095	13.47	9.82	45.10	22.75	25.77
S.E. ±	4333	0.32	0.06	0.17	0.273	0.260	0.300	0.681	0.546	0.527	0.025	0.013	0.023	0.25	0.12	0.25	0.28	0.66
C.D. (P=0.05)	N.S.	0.64	0.12	0.34	0.541	0.531	0.594	1.190	1.081	1.043	0.050	0.026	0.045	0.49	0.24	0.49	0.56	1.31

NS - Non significant

solar radiation. However, plant height and number of branches could not be influenced significantly by cropping systems. It might be due to french bean competition with potato as also reported by Ahlawat (1998).

The yield of attributed *viz.*, number of pods/plant, pods length and 100 grains weight were recorded significantly higher in intercropping than pure french bean. The translocation of more nutrients from vegetative parts to reproductive organs of crop plants due to better growth might have improved the yield attributes of french bean in intercropping system (Table 1).

Grain and straw yields per unit area were recorded significantly higher in pure french bean than intercropping and these are directly associated with more plant stand of french bean. Though, individual plants did better in intercropping but those could not compensate the losses caused by lower plant stand. Ahlawat (1998) also reported significantly higher yield of french bean in sole cropping than inter cropping system (Table 1).

Effect of potassium:

The increase levels of potassium showed significant increase in growth character *viz.*, plant height, number of branches/plant, dry matter/plant, crop growth rate, relative growth rate and net assimilation rate upto the application of highest dose of 60 kg K_2O/ha, however, in few cases increase beyond K3O dose was not significant. Similar results have been reported by Bhaskar *et al.* (2001).

The yield attributes *viz.*, number of pods/plant, pod length, 100- grains weight and yields per unit area of grain and straw showed significant increase with increasing K-level upto 60 kg K_2O/ha. These might be attributed to more utilization of potassium at increased rate of applications which met out the requirement of crop to produce high yield attributes and ultimately the yields of french been. The results confirm the

finding of Singh and Tripathi (1994) and Bhaskar *et al.* (2001).

Effect of nitrogen:

All growth characters displayed in (Table 1) were improved significantly by application of increased doses of nitrogen mostly upto 180 kg N/ha. It might by due to more absorption and utilization of nitrogen by crop plants which caused more cell elongation and carbohydrate production the two important characters responsible for growth. It may be supported by the finding of Jha *et al.* (2000).

Yield attributes and yields of french bean as indicate in the (Table 1) showed significant increase in N levels upto the application of 120 Kg N/ha in most of the cases. These affects are attributed to better growth parameters of french bean at increased application of N. Besides, the translocation of carbohydrate and proteins from vegetative parts to reproductive parts of crop plant might have caused improvement in different yield attributes which ultimately enhanced grain and straw yields at increased application of nitrogen. Ali and Lal (1991) also reported that french bean is inefficient in symbiotic nitrogen fixation because of poor root nodulation thus responds well to higher dose of nitrogen application.

Potato crop:

Effect of cropping systems:

Plant stand of potato was significantly more in pure cropping than intercropping system as only 40 per cent area was sown with inter cropping against 100 per cent in pure crop. Potato in intercropping system attained significantly more plant height than in sole cropping. Dry matter accumulation and Tuber number per plant were not affected significantly but tube size and tuber weight/ plant were produced significantly higher in pure crop than inter cropping system. Tuber yield per unit area was significantly higher in sole cropping than intercropping system by margin of 95 q/ha or 38.6%. The lesser tuber yields in intercropping could be attributed to reduced plant density per unit area and also to the competition effect with french bean, Singh *et al.* (2002) also reported the similar results in potato+french bean intercropping (Table 2).

Effect of potassium:

Growth of Potato was not influenced significantly by K-Levels, while among yield attributes, no. of tuber/ plant and tuber weight per plant increased significantly with increasing K-Level upto 60 Kg K_2O/ha. The application of 60 kg K_2O/ha produced significantly higher (198.25/ha), tuber yield which was 7.39 and 20.84 q/ha or 3.87 and 11.25% higher compared with K_{30} and K_0

Table 2 : Growth and yield of potato under different treatments (Pooled)

Treatments	Plant stand/ha	Plant height (cm)	Dry matter/ plant (g)	No. of tuber per plant	Tuber size (cc)	Tuber weight/ plant (g)	Tuber yield (q/ha)
System of cropping							
Sole Crop.	83404.60	41.17	73.17	10.67	235	298.9	241.8
Inter Crop.	57641.20	44.51	73.25	10.62	228	279.4	136.09
S.E. ±	129.90	0.17	0.26	0.10	225	2.53	1.62
C.D. (P=0.05)	270.90	0.36	N.S.	N.S.	4.69	5.28	3.39
K. Levels Kg/ha							
K_0	70198.20	42.88	73.16	9.89	229.35	281.8	177.41
K_{30}	70580.80	42.66	72.90	10.88	231.18	288.2	190.8
K_{60}	70788.90	42.98	73.60	11.17	234.65	297.5	198.2
S.E. ±	159.10	0.21	0.31	0.12	2.75	3.01	1.99
C.D. (P=0.05)	N.S.	N.S.	N.S.	0.25	N.S.	6.47	4.15
N. Levels Kg/ha							
N_0	70126.40	38.28	64.52	8.99	208.01	234.5	149.2
N_{60}	70385.30	42.28	-64.24	10.25	227.25	281.03	183.4
N_{120}	70624.20	44.42	76.90	11.48	248.94	319.67	209.25
N_{180}	70955.80	46.35	77.18	11.48	242.64	321.67	213.50
S.E. ±	223.50	0.36	0.51	0.20	2.04	3.14	2.92
C.D. (P=0.05)	N.S.	0.71	1.01	0.40	4.07	6.32	5.70

NS-Non significant

levels, respectively. These results are in accordance to those of Goswami (2002), Kumar *et al.* (2002) and Pal *et al.* (2002).

Effect of N levels:

N levels resulted significantly tallest plants at N 180kg/ha dose. Dry matter/plant also showed significant increase upto highest tested dose of 180 Kg N/ha. Number of tuber per plant, tuber size and tuber weight/plant showed significant increase upto the dose of 120 kg N/ha.

Tuber yield/unit area increased with increasing levels of nitrogen upto 180 Kg N/ha but the margin of increase beyond 120 Kg N/ha was not significant. The dose of 120 Kg N/a produced 209.25 q/ha tuber yield which was found 25.85 q/ha or 14.1% and 60.05 q/ha 40.2% higher over the tuber yields at N_{60} and N_0 levels, respectively. Such higher tuber yields are attributed to better yield attributes. Similar finding have been reported by Dhangal *et al.* (2001) and Singh *et al.* (2002).

Table 3 : Frenchbean grain equivalent yield q/ha and L.E.R. under different treatment

Treatment	Yield q/ha (Pooled)	L.E.R.
System of cropping		
Frenchbeam sale	24.40	1.0
Potato Sole	29.00	1.0
Frenchbean + Potato	31.28	1.17
S.E. ±	0.28	0.11
C.D. (P=0.05)	0.54	N.S.
K Level Kg/ha		
K_0	26.46	1.21
K_{30}	28.60	1.17
K_{60}	29.63	1.13
S.E. ±	0.22	0.01
C.D. (P=0.05)	0.45	0.02
N. Levels Kg/ha		
N_0	21.85	1.17
N_{60}	27.52	1.18
N_{120}	31.90	1.17
N_{180}	32.07	1.17
S.E. ±	0.22	0.01
C.D. (P=0.05)	0.43	N.S.

Equivalent yield (q/ha):

Effect of cropping system:

The intercropping of french bean + Potato has produced significantly maximum french bean equivalent yield. It was followed by potato sole crop while french bean sole produced significantly minimum equivalent yield. The intercropping system produced 31.28 q/ha french bean equivalent yield which was 2.28 q/ha or 7.95% and 6.88 q/ha or 28.20% higher than sole potato and pure french bean, respectively. L.E.R. was also recorded maximum of 1.17 in intercropping system (Table 3).

Effect of K levels:

In case of K levels equivalent yield significantly increased upto highest tested dose of 60 kg K_2O/ha which produces 29.63 q/ha equivalent yield which was 1.03 q/ha or 3.6% and 3.17 q/ha or 11.98% higher than K_{30} and K_0 levels, respectively. L.E.R. was recorded significantly maximum of 1.21 in control and maximum of 1.31 at 60 kg K_2O/ha.

Effect of nitrogen:

Nitrogen application increased equivalent yield significantly upto the dose of 120 kg N/ha which produced 31.90 q/ha 31.90 q/ha equivalent yield and it was found 4.38 q/ha or 15.92% and 10.05 q/ha or 46.9% higher than the equivalent yield at N60 and No dose, respectively. L.E.R. was not influenced significantly by nitrogen levels. These results are in accordance with the findings of Ahlawat (1998), Jha *et al.* (2000) and Dua *et al.* (2002) who reported higher production and L.E.R in intercropping system (Table 3).

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Received : April, 2008; Accepted : November, 2008